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Assessing the Effectiveness of Corn Rootworm Control and Areawide Management of Corn Rootworms

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Assessing Corn Rootworm Larval Control

Corn rootworm populations have been high the last couple of seasons. The higher density of the pest generates questions concerning the effectiveness of corn rootworm controls that have been used, especially insecticides. Corn rootworm infestations, and their injury, tend to be variable (spotty) across a field of corn. If more then a node of roots has been destroyed and there is a wind, the corn is likely to be lodged. The lodging provides a visual manifestation of the corn rootworm larval feeding. Because the infestations are not uniform across a field, the lodging is also variable. If one were to want to obtain the worst possible root-injury rating for the field, they would select lodged plants to dig and rate. If one wanted to produce a lower rating, say if they were responsible for the product applied to control the rootworm, they could choose plants that were not lodged. Therefore the rating of corn rootworm larval injury to corn can be biased by selectively sampling plants based on the above ground appearance, lodged or not lodged. To be fair to growers AND the vendor of a rootworm control product, an unbiased sampling program should be used.

Variability in sampling results from measurement errors and differences in level of infestation across a field. Variability in making the measurements, i.e., assigning a root rating, can be reduced by increasing sample size (digging more roots). Variation in the level of insect infestation throughout a field can be accounted for by assigning sample units so that they fairly represent all areas of the field and are not unduly weighted by one area. The appropriate number of samples to take to provide an acceptable level of precision is calculated by determining the variability among measurements, assigning a level of precision desired, and specifying the willingness to be wrong. How this prescribed number of samples is assigned to a field depends on the spatial variability of what is being measured; in the case of rootworm larval injury, this is usually root injury.

The spatial variability of corn rootworm larval injury was measured during 2002 by using grid sampling at three different scales, moving out from single plant. The distribution of rootworm larvae and their injury was mapped using Geographical Information Systems (GIS) and analyzed using Geostatistics. Knowing the size and distribution of corn rootworm aggregations in a field allows the efficient allocation of sampling resources to avoid repetitive sampling. A sample size and method for allocating resources will be presented, and a way of selecting plants that is free of bias will be demonstrated.

Areawide Control of Corn Rootworms

In 1997 through 2002, an areawide management corn rootworm project was conducted in Clinton County Iowa. The areawide management involved scouting rootworms in all cornfields within in a 16 square-mile area (4 x 4) and applying a broadcast treatment to control beetles before they laid eggs if the beetle numbers exceeded the economic threshold. Beetles were sampled using yellow sticky cards. Treatments were applied if numbers exceeded 6 beetles/trap/day during the first three summers and 4 beetles/trap/day during the last two years. The chemical used to control beetles was Slam, an insecticidal bait. The formulation was applied by aircraft at ½ pound per acre in a gallon of water with carbaryl insecticide. The attractant in the bait was cucurbitacin, a feeding stimulant for adult corn rootworms. Because the beetles were induced to eat the formulation, only an ounce of insecticide per acre was applied instead of the standard one pound. The effectiveness and efficiency of the program was evaluated by determining the rootworm densities and larval injury in fields in the managed area compared to fields outside the area where farmers applied their own controls, usually soil insecticides at planting.

If areawide management were to be judged a success, the cost of coordinated management should be less than individual farmer costs, there would be less insecticide applied to the fields, and there would be no more injury suffered than when traditional chemical controls were used. After the initial year of spraying (1997) and the final year (2002), the beetle treatments reduced the corn rootworm population in the management area to ¼ or ½ those in the farmer-managed fields (Fig. 1). The suppression of the populations reduced the number of acres that had to be treated, and therefore reduced treatment costs (Table 1). Because a low dose of insecticide was used, the treated fields received only 1/16 the rate of insecticides normally applied to the soil and there was a further reduction because the number of acres treated was reduced.

On the average, the root injury ratings in the adult management area were similar to the ratings from where soil insecticides were used (Table 2). The range in the ratings in the management area, however, was wider; that means that the areawide beetle-management program was more variable than the protection provided by soil insecticides. The wider range meant that at times beetle control was much better than soil insecticides and others it was much worst. To date the reason for this variability is not understood. A detailed spatial analysis of cropping patterns and production practices, soil characteristics, and rootworm densities is being conducted to further understand the variability in corn rootworm control during areawide management of beetles.

Figure 1. Number of adult corn rootworms produced in areawide management fields and field managed as individual units by growers.

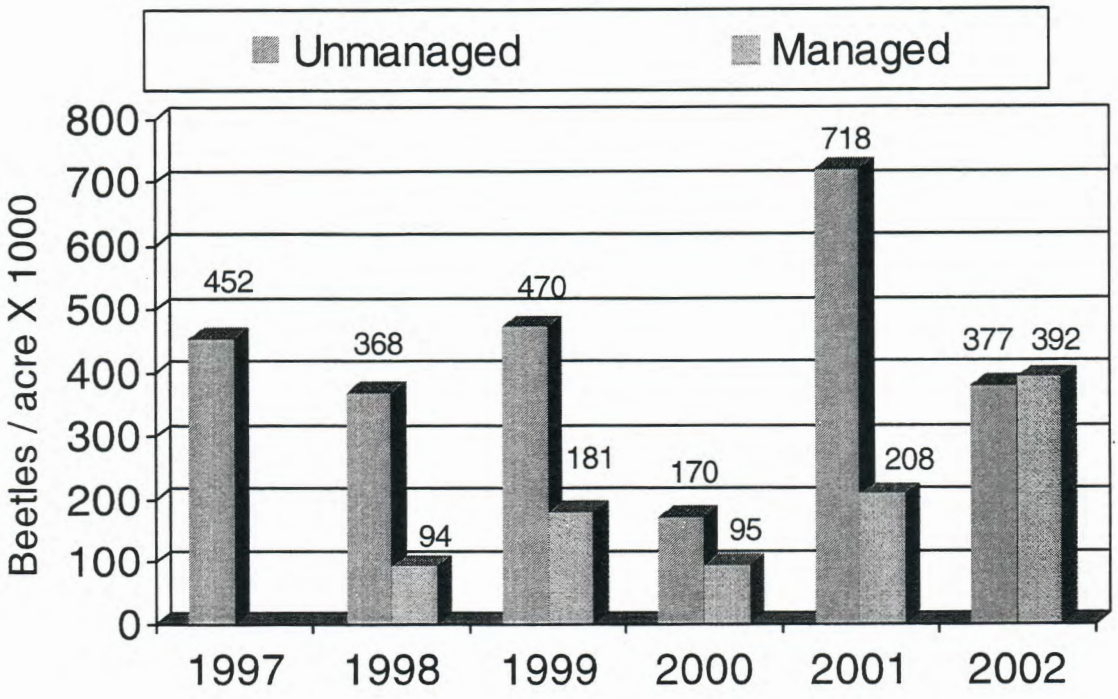

Table 1. Number of acres scouted and treated for adult corn rootworm control in the Iowa areawide corn rootworm management project. Clinton County, Iowa.

Year	Acres Scouted	Acres Treated Once (%)	Acres Treated Twice (%)
1997	6,020	5,607 (93)	3,020 (50)
1998	6,829	3,082 (45)	110 (1.6)
1999	6,456	5,720 (89)	1,473 (23)
2000	6,262	1,163 (19)	0
2001	5,798	2,829 (51)	476 (9)

Table 2. Root injury ratings (1-6 scale) in the areawide project managed area and comparison companion area. Number in parentheses is the range.

Year	Management Area	Companion Area	
		Soil Insecticide	No Treatment
1998	2.2 (1.3-3.3)	2.0 (1.5-2.7)	3.5 (2.1-5.0)
1999	2.6 (1.0-5.2)	2.7 (2.0-3.4)	3.6 (2.6-4.8)
2000	1.4 (1.0-4.8)	1.5 (1.0-2.8)	2.5 (1.1-4.4)
2001	1.9 (1.0-4.9)	2.0 (1.7-3.3)	2.0 (1.8-4.9)
2002	3.1 (2.0-6.0)	2.9 (2.0-4.0)	3.8 (2.0-6.0)